FUNERAL CASTINGS PRODUCED IN COBURG WORKS
FOUNDRIES IN SLOVAKIA, 19TH CENTURY

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SUMMARY

The paper presents results of chemical and metallographic analysis of funeral castings produced in the second half of the 19th century and at the beginning of the 20th century in central Slovakia. The castings were collected from abandoned graves at cemeteries of villages in the upper Hron river region.

Key words: Funeral castings; Coburg ironworks; Cupola furnaces.

1. INTRODUCTION

Long traditions of iron production in the upper Hron river region reflected also in character of local cemeteries that were typical by grave crosses made of cast iron. Main function of the crosses was the identification of the graves. Also decorative fences around graves could contain cast iron castings. The tombstone crosses were sacrificed namely by Roman Catholic and Orthodox churches. The cross itself was understood as a symbol of belief, eternal life, infinite love and suffering. The use of grave crosses at our territory started in the 15th – 16th centuries.

The paper presents analysis of grave crosses and some other cast iron castings collected from abandoned graves in a few village cemeteries around the upper Hron river. The castings, dated to the 19th century and to the beginning of the 20th century, were produced in foundries of Coburg ironworks, the only ironworks in the region.
2. THE COBURG IRONWORKS

The Coburg family ironworks were situated in the valley of the upper Hron river and in vicinity (Gemer region), Fig. 1 [1]. The family owned or hired seven blast furnace plants and built and managed rolling mills for production of rails, sheets and bars. Pig iron, product of blast furnaces, was refined in refining hearths, that were replaced in the half of the 19th century by Comté – hearths. In 1847 the first foundry in the ironworks was built in Ferdinandova huta (Pohorelá).

The foundry in Ferdinandova huta used reverberatory furnace and cupola furnace for production of cast iron. In 1892 cupola furnace was built instead of reverberatory furnace [2,3]. The foundry produced castings mostly for needs of the Coburg works, for needs of iron machinery shops. Driving wheels, turbines and other parts of machinery, used in iron works and mines, were produced. At industrial fair in 1857 the Coburg works exhibited a steam engine produced in works machinery shops. The foundry was well – known for production of artistic castings.

The Coburg works bought in 1916 Heinzelmann ironworks in Chyžnianska Voda [4], where besides blast furnace also cupola furnace and foundry shop worked. The foundry shop produced various kinds of vessels and some kinds of machinery parts. Production of artistic castings in Chyžnianska Voda ironworks was not recorded. Besides production of castings in foundry shops the castings were also produced by direct casting of molten pig iron after tapping from blast furnace.
3. SAMPLING OF FUNERAL CASTINGS

Cast iron grave crosses form about 70% of all funeral castings. Classic shape of crosses, when Christ’s body and arms were not covered by ornamentation, was changed in the second half of the 19th century to crosses with rich ornamentation that covered whole area of the cross. The cross contained also a plate with data of deceased, that was situated under Christ’s body. The plates were ornamented on periphery [5,6].

Problematics of artistic funeral castings has not been studied at our territory till present. Funeral castings at cemeteries around Hronec and Pohronská Polhora were described in the literature [5,6] without attempts to discuss ways of their production.

Funeral castings described in this paper, consisted of grave crosses, grave fences and one ornamental casting situated on grave plate. The castings were collected from abandoned graves dated to the second half of the 19th century and beginning of the 20th century. Three materials were collected in Švábolka cemetery. The first one represented dark grey casting of Christ’s corpus, fig. 2. One sample, L1, was taken from the right wrist of the body. The second material, L2, represented stem of the cross. Two samples were taken, from the rim of the fragment and from the inside of the fragment. The third material, light grey casting of Christ’s corpus, L3 was sampled by the same way as the L1 one.

From Pohorelská Maša cemetery one material, fragment of the cross with beams, L4, was included into the set of analysed castings. The cross was dated to 1914. Two samples were taken, L4a from the beam, L4b from the cross arm.

Three materials were collected in Červená Skala cemetery. The first one, L5, rolled steel product, came from the grave fence. Two samples were taken, L5a from the fence rod, L5b from the fence screw. The second material, L6, represented a fragment of cross heel. The third material, L7, was found by a grave. The piece was made from cast iron, the sample was taken from the rim of the piece.

Two materials were collected in Zlatno cemetery. The material L8, Fig.3, represented fragment of the cross beams. Two samples were taken, the first one, L8a,
from the place where the beams were joined to the cross, the second one, L8b, from one of the beams. The material L9 represented rolled steel strip. The sample was taken by cross-section cut from the strip end.

The last material came from Šumiac cemetery. It was a fragment of lily flower casting situated on the top of a grave plate. The sample was taken from the end of the fragment, designated as L10. The grave was dated to 1867.

4. ANALYSIS OF SAMPLES

Chemical and microscopic analyses were performed at the samples. To do it, the samples were divided to two parts. The first one, after drilling, was used for classical chemical analysis, the second one, after preparing the metallographic surface, for observation under metallographic optic microscope.

Results of chemical analysis are in Table I.

<table>
<thead>
<tr>
<th>Sample no.</th>
<th>C</th>
<th>Si</th>
<th>Mn</th>
<th>P</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1</td>
<td>3.80</td>
<td>1.77</td>
<td>0.80</td>
<td>0.057</td>
<td>0.020</td>
</tr>
<tr>
<td>L2a</td>
<td>3.61</td>
<td>2.45</td>
<td>1.16</td>
<td>0.059</td>
<td>0.050</td>
</tr>
<tr>
<td>L3</td>
<td>4.65</td>
<td>3.69</td>
<td>0.90</td>
<td>0.034</td>
<td>0.099</td>
</tr>
<tr>
<td>L4a</td>
<td>3.42</td>
<td>2.81</td>
<td>0.51</td>
<td>0.052</td>
<td>0.089</td>
</tr>
<tr>
<td>L4b</td>
<td>3.61</td>
<td>2.52</td>
<td>0.38</td>
<td>0.027</td>
<td>0.054</td>
</tr>
<tr>
<td>L5a</td>
<td>0.35</td>
<td>0.50</td>
<td>0.15</td>
<td>0.080</td>
<td>0.018</td>
</tr>
<tr>
<td>L5b</td>
<td>0.33</td>
<td>0.21</td>
<td>0.13</td>
<td>0.020</td>
<td>0.027</td>
</tr>
<tr>
<td>L6</td>
<td>4.27</td>
<td>1.79</td>
<td>1.15</td>
<td>0.060</td>
<td>0.045</td>
</tr>
<tr>
<td>L7</td>
<td>3.80</td>
<td>4.65</td>
<td>1.37</td>
<td>0.069</td>
<td>0.078</td>
</tr>
<tr>
<td>L8a</td>
<td>3.80</td>
<td>3.31</td>
<td>1.13</td>
<td>0.056</td>
<td>0.100</td>
</tr>
<tr>
<td>L9</td>
<td>0.19</td>
<td>0.22</td>
<td>0.34</td>
<td>0.085</td>
<td>0.002</td>
</tr>
<tr>
<td>L10</td>
<td>4.08</td>
<td>2.86</td>
<td>0.57</td>
<td>0.070</td>
<td>0.081</td>
</tr>
</tbody>
</table>

It follows the data in the table that most of analysed samples represented cast iron castings. Differences in chemical composition of the samples reflected the time range in which the castings were produced (about 60 years). Carbon contents varied from 3.42% to 4.65%. Big differences were found in silicon contents. The authors have not any information about composition of castings from Pohorelá foundry. Sulphur contents raise the questions concerning compositions of cupola or reverberatory furnaces charges. The sample L10 was from the grave dated to 1867, when no pig iron from coke blast furnace was in disposition at our territory.

The samples L5a, L5b and L9 represented rolled steel products. Their composition is normal but sulphur contents. Steel L5a and L5b was probably made by refining of coke blast furnace pig iron. The sample L9 had sulphur content 0.002%, typical for steel refined from pig iron produced in charcoal blast furnace. It was
impossible to recognize if fence materials L5 were rolled in the Coburg rolling mills, but no coke blast furnace worked in the Coburg ironworks.

Microscopic observations of cast iron samples showed typical structure of cast iron with graphite flakes. The shape of flakes changed from thick ones to thin and little ones in individual samples. It followed probably from overheating of the melt or prolonged holding at temperature, but different compositions of the melts could play the role in cooling rate. After etching in nital pearlitic structure with phosphidic eutectics network was observed, Fig.4, in the sample L4 little ferritic grains were found. In the sample L8a, taken from the place of joining of beams to cross, spots of ledeburite were observed in pearlitic structure. The structure of the beam itself was ledeburitic, Fig.5. The structure of lily flower casting L10 contained nests of graphite flakes, but with many empty spots, that contained ledeburitic structure.

The grave fence and the fence screw, the samples L5a and L5b, were made of steel. The material contained a lot of smithy inclusions and inclusions of scales. The fence bar was carburized from one side, the opposite side contained only non–carburized iron material with coarse ferritic structure. The material of screw was deep carburized. Analysis of the sample L9, rolled steel strip, showed fine grained ferritic–pearlitic structure with very low content of pearlite.

5. DISCUSSION

Funeral castings collected at cemeteries in the upper Hron river region were probably produced in foundry of Ferdinandová huta in Pohorelá. Analysed castings were produced in relatively long time range about 60 years. This fact was reflected in different compositions and structures of the castings. The variability was probably caused by:
- changes in foundry technology;
- changes in foundry technique;
- changes in composition of cupola or reverberatory furnaces charge;
little attention to quality of funeral castings because no special utility properties were needed.

Different, but in most castings high contents of silicon had important effect on cooling rate and on structure of castings. As a result different shapes of graphite flakes originated. Very high cooling rate under temperature of eutectics caused formation of ledeburite, as was observed in thin castings of beams and to some extent in lily flower casting.

Another question arose from sulphur contents of analysed castings. All blast furnaces of the Coburg works were charcoal blast furnaces, that produced pig iron with very low sulphur contents. The source of sulphur in castings was the fuel used in a cupola’s furnace. It could be either coal or coke produced in north Moravian or Silesian cokeries.

Steel rod of the grave fence was carburized from one side. Such treatment of rods was not necessary. The fence was probably made of iron materials of different kinds selected by chance. Analysis of thin steel strip showed evenly distributed fine grained ferritic – pearlitic structure that proved high quality of rolled steel products of the Coburg works.

6. CONCLUSIONS

The paper presents results of chemical and metallographic analyses of funeral castings that were collected from abandoned graves at cemeteries of villages in the upper river Hron region where the Coburg ironworks were the only producer of castings in that time. Analysed funeral castings consisted of grave crosses, grave fences and one casting situated on the grave plate. It followed from analyses that:

1. Big differences in chemical composition of castings were found, especially in carbon and silicon contents. The castings were made of cast iron.
2. As metallic charge of cupola furnaces consisted mostly of pig iron produced in charcoal blast furnaces, increased sulphur contents in cast iron had source in fuel used in cupola furnace.
3. Cast iron was of flake graphite type with different flake shapes in individual castings, caused by different, but high cooling rate.
4. No special attention was paid to the production of funeral castings.
5. Grave fences were made of steel rods. Also in this case no special attention was paid to the selection of steel rods.
6. Presented analysis of funeral castings is the first of this kind on the territory of Slovakia, where traditions of funeral castings use started in the 15th century.
REFERENCES


Recenzent: prof. dr hab. inż. Czesław Podrzucki.

ODLEWY CMENTARNE WYTWARZANE W XIX WIEKU W ODLEWINACH SŁOWACKIEJ HUTY COBURG

Długa tradycja wytwarzania żelaza w górnym dorzeczu rzeki Hron na Słowacji znajduje swe odbicie w charakterze lokalnych cmentarzy, które wyróżniały się żeliwnymi krzyżami nagrobkowymi; praktyka przyozdabiania nagrobków tego rodzaju odlewami sięga 15 stulecia. Odlewy żeliwne stanowiły również elementy ogrodzeń nagrobków.

W artykule przedstawiono wyniki analizy chemicznej i badań struktury odlewów żeliwnych, zebranych na opuszczonych cmentarzach regionu nad górnego biegu rzeki Hron. Pochodzą one z odlewni Huty Coburg, jedynego zakładu metalurgicznego w tym regionie; były wytwarzane w ciągu ok. 60 lat, wieku 19. i w pierwszych latach wieku 20. Około 70 % zebranych odlewów, poddanych analizie, stanowiły krzyże nagrobkowe.

Żeliwo na analizowane odlewy wytapiano w piecach płomieniowych i w żeliwiarach. Z uwagi na szeroki zakres czasowy uwzględniony w badaniach zaobserwowano znaczne zróżnicowanie składu chemicznego i struktury badanych odlewów. Jego przyczynami były następujące czynniki: zmiany w technologii wytwarzania odlewów, zmiany rodzaju i składu chemicznego wsadu metalowego, poświęcanie małej uwagi zagadnieniom jakości omawianych odlewów, gdyż nie wymagano od nich szczególnych właściwości użytkowych.
Odlewy odznaczały się różnicą, na ogół jednak znaczną zawartością krzemu, co nie zawsze eliminowało jednak pojawianie się eutektyki cementytowej w cienkościennych, ozdobnych częściach odlewów.

Charakterystyczna dla odlewów była bardzo mała zawartość w nich siarki, jako skutek wytwarzania surówki wielkopiecowej, wykorzystywanej w procesach otrzymywania ciekłego żelwa, z zastosowaniem węgla drzewnego.

Do wykonywania ogrodzeń nagrobkowych stosowano na ogół pręty stalowe, przy czym nie zwracano tu uwagi na rodzaj i jakość materiału.

Przedstawiona w referacie analiza odlewów nagrobkowych jest pierwszą analizą odlewów tego rodzaju, dokonaną w Słowacji, mimo iż tradycja ich stosowania sięga XV wieku.